of overall and recurrence-free survival, longer follow-up is required, because a full evaluation of the survival endpoints will require greater maturity of time-to-event data. Thymoma is an indolent disease, and longer follow-up is needed to determine the oncologic outcomes of VATS thymectomy. In addition, the use of the minimally invasive VATS approach was started later than use of the open procedure; thus, the VATS patients require additional observation for follow-up equivalence.

CONCLUSIONS

To our knowledge, the present series is the largest published report comparing the outcomes of a minimally invasive thoracoscopic resection of thymoma with those of an open technique. VATS resection of early-stage thymoma appears feasible and safe and was associated with a shorter hospital LOS. The oncologic outcomes also appear equivalent in the open and VATS groups during intermediate-term follow-up. Additional follow-up is required to evaluate the long-term results of thoracoscopic thymectomy for early-stage thymoma.

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Discussion

Dr Nasser Altorki *(New York, NY).* I have a question for you. I disagree with 4 of your 5 conclusions. I think to talk about oncologic validity in thymoma with anything that is less than 5 years, or preferably 10 years, is probably not correct. Thirty six months is just way too short of a follow-up to be able to tell that. How did you follow-up those patients? How carefully did you follow-up those patients?

Dr Pennathur. Well, we have acknowledged in our conclusions that longer follow-up is required. We saw all of these patients in the clinic typically about every 4 to 6 months. Now, the myasthenia patients were also followed very closely by the neurologist, and that follow-up was actually a little bit closer, about 3 months. So I would say that the myasthenia patients were a little bit more closely followed-up compared with the nonmyasthenic thymoma patients.

Dr Altorki. My concern is that I have seen some of those patients come after transpleural resections, and sometimes you

have to enter the pleural space and they will come back 10 years later, 12 years later, with pleural implants in the posterior gutters, basically in both pleural spaces, and that is one reason that I have found the video-assisted thoracoscopic surgery approach a little bit intimidating, at least for me.

Dr Pennathur. Yes, I think your point is very valid. I agree that we need longer follow-up, to fully evaluate the results, which we have acknowledged in the conclusions. However, there is no series in the literature to my knowledge evaluating outcomes comparing a thoracoscopic approach to an open approach at this length of follow-up (36 months), and that is what we have attempted to do. Also, in terms of the pleural droplet metastasis which does occur in thymoma, the thoracoscopic approach provides good visualization. The first thing you do is explore the chest and we are able to actually get a good view of the pleura space with the thoracoscopic approach.

Dr Federico Venuta *(Rome, Italy).* I was reading your abstract and I noted in the abstract that you reported 3 patients with positive margins but in your presentation there was only 1 patient with a positive margin in the thoracoscopic group.

Dr Pennathur. Yes. That is an error in the abstract. It is 1 patient with a positive margin.

Dr Venuta. And if I may ask another question, how did you divide these patients with the 2 approaches? How did you decide who received the open approach and who received the thoracoscopic approach?

Dr Pennathur. This is certainly not a randomized study, so there is clearly a selection bias in terms of the surgeon and the patient in deciding the approach. In general, if the thymoma is less than about 5 cm or so, particularly in the early stage of performing these thoracoscopic thymectomies, we preferred to do those thymomas that looked small and encapsulated. Some of them on final pathology, however, had capsular invasion, putting them as a stage II. When there was concern about invasion into adjacent structures or bigger lesions, those were handled by an open approach. The largest lesion in this series in the video-assisted thoracoscopic surgery approach was 5.6 cm and the median was 3.6 cm. So I think it is the size, the appearance on the CT scan, relationship to adjacent structures, and, of course, there is a selection bias in terms of the surgeon who is doing the case. This is a retrospective study. It's not a prospective randomized study.

Dr Venuta. What are your indications for postoperative radiotherapy?

Dr Pennathur. Well, I know this is being debated. Dr Wright at Massachusetts General had presented a series on the usefulness of radiation for stage II and a similar series has been presented by Dr Singhal from the University of Pennsylvania questioning the value of radiation. In our institution, if it's a stage II or higher, we give consideration for radiation therapy. Other considerations for radiation include positive margins and more advanced tumors. But I think this is something is being questioned. The recurrences occur many times in the pleura, as Dr Altorki pointed out, so radiating them in the chest—the thymic bed—may not entirely be effective.

Dr Raphael Bueno *(Boston, Mass).* Nice paper and I think it will take time to figure out what the answer is. You had another parameter besides oncologic, which is the recurrence of myasthenia. Did that differ in the 2 groups?

Dr Pennathur. No, it did not differ. The bottom line was that the Osserman score showed a significant improvement in both the groups. Nine out of 11 patients with myasthenia improved. The Osserman score had a mean drop of negative 2, which is an overall improvement. We did not find significant differences between the surgical groups.

Dr Michael Jaklitsch *(Boston, Mass).* My personal inhibition against doing a thoracoscopic thymectomy for thymoma is from my personal experience, in that in dissecting out the gland, I can see micro-defects in the capsule of the gland, and what makes you stage I is having that gland intact. I have used a variety of techniques, but I can see these little nicks, which I do not get with a partial sternotomy. Am I different from you and you have a technique that you can get the gland out without capsular nicks, or am I like you and we are both getting capsular nicks but you are showing me oncologically that those nicks do not matter?

Dr Pennathur. Well, I think that there are various ways of mobilizing the thymus, and one way, for example, described by Dr Augasthian at the Society of Thoracic Surgeons, which is similar to ours, is we do not handle the tumor first. Try to go toward more of the normal thymus, mobilize, and create the plane before obviously going where the mass is and before trying to mobilize the mass initially. So, if you start from the normal tissue and start mobilizing from there, that helps. The other thing that we have done over the years with the evolution of the technique is that we have used a bilateral approach. You get a very good look at the left side. We start mobilization on the left side, and then as we move along, the patient is placed supine, which also helps with easy conversion, if needed; and then we go to the right side, and, again, you can take from the normal tissue and then mobilize it, and then you will be able to potentially avoid some of those nicks. But it can be a problem. One has to handle the capsule very carefully.

Dr Thomas Rice *(Cleveland, Ohio).* Beyond the short follow-up and the few events, you have to ask: Are these comparable groups? So when you come to doing your multivariable analysis when you get enough events, even if you do not have enough patients, you should put the propensity score in the multivariable analysis to see if it is a fair comparison. It probably is not.

Dr Pennathur. Dr Rice, thank you for your comments. Yes, we can certainly consider doing that—trying to adjust for the various variables. One thing we found was that size was bigger in the open group.

Dr Nasser Altorki *(New York, NY).* Perhaps you have done it already, but let me just make a pitch for the partial sternal splits, which are ideally suited for small thymomas of the superior mediastinum, because I do agree that your length of stay can probably be shortened.

Dr Pennathur. Yes. Thanks for your comments. I want to thank the Society for the opportunity to present this paper.